



PATENT APPLICATION

IN THE U.S. PATENT AND TRADEMARK OFFICE

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Applicants: Yutaka MIYAMOTO et al

For: BUTT WELDING APPARATUS AND BUTT WELDING METHOD

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Commissioner for Patents
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SUPPLEMENTAL APPELLANTS' BRIEF ON APPEAL

Sir:

This is an appeal from the decision of the Examiner dated March 26, 2007, finally rejecting Claims 23-44.

REAL PARTY IN INTEREST

Kikuchi Co., Ltd. is the assignee of the present application and the real party in interest.

RELATED APPEALS AND INTERFERENCES

There currently are no related appeals or interferences.

STATUS OF CLAIMS

Claims 23-44 have been rejected and are the claims under consideration on appeal. Claims 1-22 have been cancelled.

STATUS OF AMENDMENTS

An amendment after final rejection has not been filed in the present application.

SUMMARY OF CLAIMED SUBJECT MATTER

Appellants' invention, as defined by independent Claim 23, is directed to a butt welding apparatus for butt welding end faces of at least one plate member by electric resistance heating, comprising means for supporting the at least one plate member such that the end faces abut each other and form a butt portion (clean copy of specification page 14, lines 23-26; Figure 1, numerals 62 and 63), the pair of electrode members disposed opposite to one another for performing electric resistance heat welding of the butt portion, the pair of electrode members comprising a first electrode member provided at a first side of the butt portion and a second electrode member provided at a second side of the butt portion opposite to the first side, the first electrode member being positioned so that it extends across the butt portion and has an outer surface with a first convex portion and gradually retreats therefrom as it extends from an intermediate portion of the first electrode member on the surface and the second electrode member being positioned such that it extends across the butt portion, and means for causing relative movement of the first and second electrode members toward each other and contacting of a surface of the at least one plate member with the first electrode member at the first side of the butt portion and surfaces of the at least one plate member on opposite sides of the butt portion, at the second side thereof, with the second electrode member and cause an end face thereof to deform toward the other end face, melt and join with the other end face (clean copy of specification page 15, lines 3-15; electrodes 1 and 2 advancing towards each other in Figures 2-4).

Claim 24 limits Claim 23 in requiring that the first electrode member additionally comprise a second convex portion connected to the first convex portion at the intermediate portion of the first electrode member and that the second convex portion gradually retreat from the at least one plate member as it extends away from the intermediate portion (clean

copy of specification page 16, lines 1-25; Figure 2, numerals 1A and 1B).

Claim 25 limits Claim 23 in requiring that the first electrode member additional comprise a flat portion connected to the first convex portion at the intermediate portion of the first electrode member with the flat portion and the intermediate portion of the first electrode member being contained in a plane which is approximately parallel to the at least one plate member (clean copy of specification page 22, lines 30-35; Figure 7, numerals 3A and 3B).

Claim 26 limits Claim 23 in requiring that the second electrode member have an outer surface with a flat portion which faces and is approximately parallel to the at least one plate member (clean copy of specification page 16, lines 26-34; Figure 2, numeral 2A).

Claim 27 limits Claim 23 in requiring that the second electrode member have an outer surface with a first convex portion which faces the at least one plate member and gradually retreats therefrom as it extends from an intermediate portion of the second electrode member outer face and a second convex portion connected to the first convex portion at the intermediate portion of the second electrode member with the second convex portion gradually retreating from the at least one plate member as it extends away from the intermediate portion of the second electrode member (clean copy of specification page 24, lines 9-14; Figure 10, numerals 4A and 4B).

Claim 28 limits Claim 23 in requiring that the second electrode member have an outer surface with a first convex portion which faces the at least one plate member and gradually retreats therefrom as it extends from an intermediate portion of the second electrode member outer face and a flat portion connected to the first convex portion at the intermediate portion of the second electrode member with the flat portion and the intermediate portion of the second electrode member being contained in a plane which is

approximately parallel to the at least one plate member (clean copy of specification page 26, lines 7-12; Figure 13, numerals 5A and 5B).

Claim 29 limits Claim 23 in requiring that the pair of electrode members are electrode rollers which roll relative to the at least one plate member (clean copy of specification page 15, lines 10-15; Figure 1, numerals 1 and 2).

Claim 30 limits Claim 23 in requiring that the pair of electrode members are block electrodes which extend along the lip of the butt portion and are means for applying a press load on the at least one plate member (clean copy of specification page 27, lines 20-31; Figure 16, numerals 11 and 12).

Claim 31 limits Claim 30 in requiring that the butt portion extend linearly and the block electrodes have linearly extending shapes corresponding to the butt portion (clean copy of specification page 27, lines 32-35; Figure 16, numerals 11, 12 and 71).

Claim 32 limits Claim 30 in requiring that the butt portion extend non-linearly and that the block electrodes have non-linearly extending shapes corresponding to the butt portion (clean copy of specification page 28, lines 33-36 through clean copy of specification page 29, lines 1-9; Figure 8, numerals 13, 14 and 77).

Claim 33 limits Claim 30 in requiring that the block electrodes have shapes corresponding to the shape of the at least one plate member (clean copy of specification page 29, lines 10-19; Figure 19, numerals 15, 16, 43 and 44).

Claim 34 limits Claim 30 in requiring that the block electrodes are arranged in respective die presses for press-forming the at least one plate member (clean copy of specification page 29, lines 23-25; Figure 20, numerals 17, 18, 45, 46, 94 and 95).

Claim 35 limits Claim 34 in requiring that the block electrodes are assembled in the respective press dies via electrically insulating members (clean copy of specification

page 29, lines 29-31; Figure 20, numerals 17, 18, 94, 94A, 95 and 95A).

Claim 36 limits Claim 23 in requiring that the electrode members are spot electrodes for spot-welding the at least one plate member (clean copy of specification page 30, lines 8-15; Figure 21, numerals 21 and 22).

Claim 37 limits Claim 36 in requiring that the spot electrodes are used to butt-weld a press-formed at least one plate member (clean copy of specification page 30, lines 21-24; Figure 21, numerals 21 and 22).

Claim 38 limits Claim 36 in requiring that the spot electrodes are arranged in respective press dies for press-forming the at least one plate member (clean copy of specification page 30, lines 25-29, numerals 94 and 95 in Figure 20).

Claim 39 limits Claim 38 in requiring that the spot electrodes are assembled in the respective press dies via electrically insulating members (clean copy of specification page 30, lines 30-35, numerals 94A and 95A in Figure 20).

Claim 40 limits Claim 23 in requiring that the at least one plate member comprise two plate members and the butt portion is formed by butting respective end faces of the two plate members to each other (clean copy of specification page 14, lines 23-26; Figure 1, numerals 31, 32 and 71).

Claim 41 limits Claim 23 in requiring that the at least one plate member comprise one plate member and the butt portion be formed by butting two end faces of the one plate member (clean copy of specification page 31, lines 1-12; Figure 22, numerals 131A and 131B).

Claim 42 limits Claim 41 in requiring that the one plate member is formed by joining a plurality of plate members (clean copy of specification page 31, lines 3-6; Figure 22, numerals 132 and 133).

Appellants' invention, as defined by independent Claim 43, is directed to a butt loading method for butt welding end faces of at least one plate member by electric resistance

heating which comprises the steps of supporting the at least one plate member such that the end faces abut each other and form a butt portion (clean copy of specification page 14, lines 23-26; Figure 1, numerals 62 and 63), providing a butt welding apparatus comprising a pair of electrode members disposed opposite to one another for performing electric resistance heat welding of the butt portion (clean copy of specification page 14, lines 31-35 through clean copy of specification page 15, lines 1-3; Figure 1, numerals 1 and 2), the pair of electrode members comprising a first electrode member provided at a first side of the butt portion and a second electrode member provided at a second side of the butt portion opposite to the first side, the first electrode member having an outer surface with a first convex portion which faces the at least one plate member and gradually retreats therefrom as it extends from the intermediate portion of the first electrode member, positioning the electrode members such as they extend across the butt portion and the intermediate portion is offset from a joint portion by an amount based on the thickness of the end faces forming the joint portion in the direction of the first convex portion (clean copy of specification page 14, lines 29-35 through clean copy of specification page 15, lines 1-3; Figure 2, numerals 1 and 2) and pressing a surface of the at least one plate member with the first electrode member at the first side of the butt portion and surfaces of the at least one plate member on opposite sides of the butt portion, at the second side thereof, with the second electrode member while performing electric resistance heating of the at least one plate member to cause an interface thereof to deform toward the other end face, melt and join with the other end face (clean copy of specification page 19, lines 27-36 through clean copy of specification page 10, lines 1-21, electrodes 1 and 2 advancing towards each other in Figures 2-4).

Claim 44 limits Claim 43 in requiring that the pair of electrode members (numerals 17 and 18 in Figure 20) are

arranged in respective press dies (numerals 94 and 95 in Figure 20) for press forming the at least one plate member (clean copy of specification page 10, lines 31-36).

GROUND OF REJECTION TO BE REVIEWED ON APPEAL

Appellants request review of the rejection of Claim 23 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claim 23 of Application Serial No. 10/486 273. Appellants also request review of the rejection of Claims 23-44 under 35 USC 103(a) as being unpatentable over JP 60-6273 (JP '273) in view of JP 8-39261 (JP '261).

ARGUMENT

In its broadest form, the presently claimed invention is directed to a butt welding apparatus and method for butt welding end faces of at least one plate member by electric resistance heating. In the apparatus and method, means are provided for supporting the at least one plate member such that end faces thereof abut each other and form a butt portion, a pair of electrode members are disposed opposite to one another to perform electric resistance heat welding of the butt portion with the first electrode member being positioned so that it extends across the butt portion and has an outer surface with a first convex portion which faces the at least one plate member and gradually retreats therefrom as it extends from the intermediate portion of the first electrode member outer surface and the second electrode member is positioned such that it extends across the butt portion and means are provided for causing relative movement of the first and second electrode members toward each other and contacting of a surface of the at least one plate member with the first electrode member at the first side of the butt portion and surfaces of the at least one plate member on the opposite sides of the butt portion, at the second side thereof, with the second electrode member and cause an end face thereof to deform toward the other end face, melt and join with the other

end face. That is, the instant invention basically requires a pair of electrode members for performing electric resistance heat welding and press forming of at least one plate member with at least one electrode member having an outer surface with a first convex portion. As will be discussed below, the prior art cited by the Examiner did not disclose the basic features of the present invention.

REJECTION OF CLAIM 23 ON THE GROUND OF NONSTATUTORY
OBVIOUSNESS-TYPE DOUBLE PATENTING OVER
CLAIM 23 OF APPLICATION SERIAL NO. 10/486 273

Claim 23 of the present invention includes a new characteristic that an electrode member extends across the butt portion and has an outer surface with a convex portion which faces the plate member and gradually retreats therefrom. The Application No. 10/486,273, however, is characterized that the apparatus includes press portions formed in electrode members for pressing one of the two welding sheet members in the thickness direction and for swelling and deforming the end surface of the welding sheet member. As shown in Figure 2 of the present invention, the one of the electrodes of the present invention has a convex portion 1A, 1B that presses an upper corner portion of the end face 31A of the plate member downwardly, and the other of the electrodes has an outer surface with a flat portion. On the contrary, as shown in Figure 2 of the Application No. 10/486,273, each of the two electrodes of the Application No. 10/486,273 has an outer surface with a stepped portion 3C, 4C as well as the first thin portion 3A, 4A and the second thick portions 3B, 4B. The first thin portions 3A, 4A of the stepped electrodes press the thick sheet member 1, and the second thick portion 3B, 4B of the electrodes press the thin sheet member 2. Each portion of the stepped electrodes flatly presses the sheet when each portion comes into contact with the sheet. The convex portions 1A, 1B of the electrodes of the present invention, on the contrary, smoothly and gradually come into contact with

the plate members. At first, the first convex portion 1A presses an upper corner portion of the end face 31A of the thick plate member 31 downwardly, and thereafter the second convex portion 1B also starts gradually pressing the thin plate member 33. As such, it is respectfully submitted that the presently claimed invention is patentably distinguishable over Claim 23 of the copending Application.

REJECTION OF CLAIMS 23-44 UNDER 35 USC 103(a)

AS BEING UNPATENTABLE OVER

JP 60-6273 IN VIEW OF JP 8-39261

JP '273 discloses a method and apparatus for manufacturing a steel belt by respectively welding the distal and proximal ends of hot-rolled coils with mutually different sheet thicknesses. The proximal end of a preceding coil and the distal end of a following coil are welded after their sheet thicknesses have been homogenized by means of pressing. The proximal end of a preceding coil and the distal end of a following coil have their thicknesses homogenized either simultaneously or individually. That is, as shown in Figure 2 of this reference, the distal end of a following coil 2 is pressed by a press machine 3 so that the end thereof is the same thickness as the proximal end of the preceding coil 1. These ends having the same thickness are then welded to each other and, as shown in Figure 2 of this reference, the welding beads 4 are removed to give the product welded sheets.

Figure 3 shows another embodiment of the invention disclosed there in which both the distal and proximal ends of following sheet 2-2 and distal sheet 1-2 are pressed by the pressing machine 3 so that the ends thereof have the same thickness. After the ends have been pressed, they are joined together and then welded to each other. While this reference discloses a first pressing step and a subsequent welding step, it does not disclose pressing means which also functions as an electrode which causes the end face of one plate or welding sheet member to deform toward the end face of another welding

sheet or plate member, melt and join therewith. Therefore, the secondary reference cited by the Examiner must provide the motivation to one of ordinary skill in the art to modify the primary JP 60-6273 reference in a manner that would yield the presently claimed invention. It is respectfully submitted that JP 8-39261 contains no such disclosure.

JP 8-39261 discloses a relay welding process for band steel in which band steel 1 is cut to have slanted ends which form mutually corresponding oblique welding faces. The welding faces of both end parts 11, 12 are respectively formed to oblique shapes in the plate width and thickness directions corresponding to each other. That is, the welding faces are cut so that when they are joined to each other, the joined portion has a thickness equal to the thicknesses of the front and back sections 12, 11 of the band steel 1. As shown in Figure 12, after the inclined faces of the front and back end sections 12, 11 are joined together, they are positioned between clamps 31, 32 and then welded by electrodes 33, 34. After being welded, the welded band steel 10 is sent to a welding after-treatment as shown in Figure 14 where cutting processing of an excessive edge protruding in the direction of the board thickness is performed. This reference has no disclosure of an electrode pressing member which causes deformation and melting of an end face of an end section of the band steel to cause it to melt, deform and bond with the end face of another band sheet. Therefore, JP 8-039261 adds nothing to the disclosure of the primary reference JP 60-6273 and the references in combination do not even present a showing of prima facie obviousness under 35 USC 103(a) of Claims 23-44.

In the final rejection, the Examiner states that that JP 60-6273 discloses that the press machine 3 is heated during a pressing operation and thus serves as a pair of oppositely arranged electric resistance heating electrodes in the last paragraph on page 5 of the English translation and Figures 2 and 3. Although this reference does disclose that the

pressing units may be heated to facilitate press molding, this reference has no suggestion with respect to the pressing members being heated to an extent that it would cause the end face of one of the trailing coils to deform toward the other end face, melt and join therewith. Moreover, the Examiner calling the pressing members 3 an electrode does not make them as such. An electrode is defined as a conductor through which electrical current enters or leaves. JP 60-6273 has no disclosure of electric current passing through the pressing members 3. Indeed, if the pressing members function as electrodes and cause the end face of one of the coils to deform, melt and join with the end face of the other coil, there would be no need for a subsequent welding operation to be carried out. Therefore, Appellants respectfully submit that the Examiner is extracting teachings out of JP 60-6273 which do not exist.

In the final rejection, the Examiner also states that JP 8-39261 shows electrode members that press upon opposite sides of butted plates to result in butt-welding of the oblique-shaped end portions. However, the currently presented claims require that the electrode members contact a surface of one of the plate members to cause the end face thereof to deform toward the end face of the other plate member, melt and join therewith. While the electrodes 33, 34 of JP 8-039261 necessarily contact with the ends of the band steel, they do not cause the end faces thereof to deform, melt and join with each other since the end faces of the band steel of JP 8-039261 are cut so that they have the thickness of the band steel where they are joined. Moreover, if the electrodes 33, 34 did have a pressing function, why does the joint formed by the joined ends have a raised surface as shown in Figure 14? The Examiner clearly is in error in his assertion that both references disclose simultaneous heating and pressing and as such, a showing of prima facie obviousness of Claims 3-11, 13-15, 19 and 23-26 under 35 USC 103(a) has not been made.

CLAIMS 25 AND 28 ARE SEPARATELY PATENTABLE
OVER THE PRIOR ART CITED BY THE EXAMINER

Claims 25 and 28 require that an electrode have an electrode surface comprising a flat portion connected to a convex portion. Neither JP 60-6273 nor JP 08-039261 disclose the provision of electrodes having a flat portion connected to a convex portion or have any disclosure which would suggest to one of ordinary skill in the art to provide pressing electrodes having such a surface. Therefore, Claims 3 and 25 are even further distinguished over the prior art cited by the Examiner.

CLAIMS 43 AND 44 ARE SEPARATELY PATENTABLE
OVER THE PRIOR ART CITED BY THE EXAMINER

In its broadest form, the invention defined by method Claims 43 and 44 is directed to a butt welding method for butt welding end faces of two welding sheet members by electric resistance heating which comprises the steps of supporting the two welding sheet members such that the end faces abut each other and form a butt portion, providing a butt welding apparatus comprising a pair of electrode members disposed opposite to one another for performing electric resistance welding of the butt portion, a pair of electrode members comprising a first electrode member having an outer surface with a convex portion provided at a first side of the butt portion and a second electrode member provided at a second side of the butt portion opposite to the first side, positioning the electrode members such that they extend across the butt portion and pressing a surface of one of the welding sheet members while performing electric resistance heating of the one welding sheet member to cause the end face thereof to deform towards the other end face forming the butt portion, melt and join therewith.

Although JP 60-6273 discloses the pressing of distal and proximal ends of hot-rolled coils to homogenize the thickness thereof prior to welding, this reference does not disclose the

performing of electric resistant heating during the pressing of a surface of the hot-rolled coils to cause an end face thereof to deform toward the other end face, melt and join therewith. This reference merely discloses the pressing of one or both end faces of hot-rolled coils to homogenize the thickness thereof and then performing welding to join the homogenized ends to each other. In the present invention, it is not necessary to homogenize the thickness of the ends of the welding sheet members prior to performing the welding. Pressing deformation is performed by the electrodes during the electric resistance heating of the welding sheet members to cause an end face thereof to deform toward an end face of another welding sheet member, melt and join therewith. JP 60-6273 clearly does not disclose these steps.

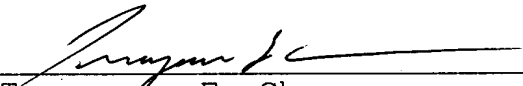
JP 8-039261 is directed to a hoop joining welding method in which the rear end of a preceding hoop and the front end of a succeeding hoop are formed in a welding face forming process to an oblique shape in the plate width and thickness directions corresponding to each other so that the joined faces have the same thickness as the preceding and succeeding hoops, and then the faces are welded in a seam welding process. Although this reference discloses contacting electrodes 33 and 34 to perform the welding of the joined ends of the band steel, like the previously discussed reference, JP 8-039261 does not disclose the electrodes pressing a surface of one of the end parts of the hoop steel while performing electric resistance heating thereof to cause an end face to deform toward the other end face of the hoop steel, melt and join therewith. Therefore, there is no disclosure in JP 8-039261 which would motivate one of ordinary skill in the art to use the pressing member disclosed in JP 60-6273 as an electrode during the pressing operation to deform the end face of one steel belt toward the end face of another steel belt, melt and join therewith. That is, since both of the cited references in combination do not disclose a critical step in the present invention, the references in combination do not

even present a showing of prima facie obviousness under 35 USC 103 of Claims 26, 13, 14, 15 and 19 and, therefore, these references are separately patentable over the cited prior art.

CONCLUSION

For the reasons advanced above, it is respectfully submitted that JP 60-6273 and JP 8-039261 in combination do not even present a showing of prima facie obviousness under 35 USC 103(a) of the claims being reviewed on appeal. Additionally, the provisional obviousness-type double-patenting rejection over Claim 23 of Serial No. 10/486 273 also is in error. As such, reversal of the Examiner is respectfully solicited.

Respectfully submitted,


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Encl: Claims Appendix
Evidence Appendix
Related Proceedings Appendix
Postal Card

136.07/05

CLAIMS APPENDIX

Listing of Claims

23. A butt welding apparatus for butt welding end faces of at least one plate member by electric resistance heating, comprising:

means for supporting the at least one plate member such that the end faces abut each other and form a butt portion;

a pair of electrode members disposed opposite to one another for performing electric resistance heat welding of the butt portion, said pair of electrode members comprising a first electrode member provided at a first side of the butt portion and a second electrode member provided at a second side of the butt portion opposite to the first side, said first electrode member being positioned so that it extends across the butt portion and having an outer surface with a first convex portion which faces the at least one plate member and gradually retreats therefrom as it extends from an intermediate portion of the first electrode member outer surface and the second electrode member being positioned such that it extends across the butt portion; and

means for causing relative movement of the first and second electrode members toward each other and contacting of a surface of the at least one plate member with the first electrode member at the first side of the butt portion and surfaces of the at least one plate member on opposite sides of the butt portion, at the second side thereof, with the second electrode member and cause an end face thereof to deform toward the other end face, melt and join with the other end face.

24. The butt welding apparatus of Claim 23, wherein the first electrode member additionally comprises a second convex portion connected to the first convex portion at the intermediate portion of the first electrode, the second convex portion gradually retreating from the at least one plate member as it extends away from the intermediate portion.

25. The butt welding apparatus of Claim 23, wherein the first electrode member additionally comprises a flat portion connected to the first convex portion at the intermediate portion of the first electrode member, the flat portion and the intermediate portion of the first electrode member being contained in a plane which is approximately parallel to the at least one plate member.

26. The butt welding apparatus of Claim 23, wherein the second electrode member has an outer surface with a flat portion which faces and is approximately parallel to the at least one plate member.

27. The butt welding apparatus of Claim 23, wherein the second electrode member has an outer surface with a first convex portion which faces the at least one plate member and gradually retreats therefrom as it extends from an intermediate portion of the second electrode member outer face and a second convex portion connected to the first convex portion at the intermediate portion of the second electrode member, the second convex portion gradually retreating from the at least one plate member as it extends away from the intermediate portion of the second electrode member.

28. The butt welding apparatus of Claim 23, wherein the second electrode member has an outer surface with a first convex portion which faces the at least one plate member and gradually retreats therefrom as it extends from an intermediate portion of the second electrode member outer face and a flat portion connected to the first convex portion at the intermediate portion of the second electrode member, the flat portion and the intermediate portion of the second electrode member being contained in a plane which is approximately parallel to the at least one plate member.

29. The butt welding apparatus of Claim 23, wherein the pair of electrode members are electrode rollers which roll relative to the at least one plate member.

30. The butt welding apparatus of Claim 23, wherein the pair of electrode members are block electrodes which extend along the length of the butt portion and are means for applying a press load on the at least one plate member.

31. The butt welding apparatus of Claim 30, wherein the butt portion extends linearly and the block electrodes have linearly extending shapes corresponding to the butt portion.

32. The butt welding apparatus of Claim 30, wherein the butt portion extends non-linearly and the block electrodes have non-linearly extending shapes corresponding to the butt portion:

33. The butt welding apparatus of Claim 30, wherein the block electrodes have shapes corresponding to the shape of the at least one plate member.

34. The butt welding apparatus of Claim 30, wherein the block electrodes are arranged in respective press dies for press-forming the at least one plate member.

35. The butt welding apparatus of Claim 34, wherein the block electrodes are assembled in the respective press dies via electrically insulating members.

36. The butt welding apparatus of Claim 23, wherein the electrode members are spot electrodes for spot-welding the at least one plate member.

37. The butt welding apparatus of Claim 36, wherein the spot electrodes are for butt-welding a press-formed at least one plate member.

38. The butt welding apparatus of Claim 36, wherein the spot electrodes are arranged in respective press dies for press-forming the at least one plate member.

39. The butt welding apparatus of Claim 38, wherein the spot electrodes are assembled in the respective press dies via electrically insulating members.

40. The butt welding apparatus of Claim 23, wherein the at least one plate member comprises two plate members and the butt portion is formed by butting respective end faces of the two plate members to each other.

41. The butt welding apparatus of Claim 23, wherein the at least one plate member comprises one plate member and the butt portion is formed by butting two end faces of the one plate member.

42. The butt welding apparatus of Claim 41, wherein the one plate member is formed by joining a plurality of plate members.

43. A butt welding method for butt welding end faces of at least one plate member by electric resistance heating, comprising the steps of:

supporting the at least one plate member such that the end faces abut each other and form a butt portion;

providing a butt welding apparatus comprising a pair of electrode members disposed opposite to one another for performing electric resistance heat welding of the butt portion, said pair of electrode members comprising a first electrode member provided at a first side of the butt portion and a second electrode member provided at a second side of the butt portion opposite to the first side, the first electrode member having an outer surface with a first convex portion which faces the at least one plate member and gradually retreats therefrom as it extends from an intermediate portion of the first electrode member;

positioning the electrode members such that they extend across the butt portion and the intermediate portion is offset from a joint portion by an amount based on the thicknesses of the end faces forming the joint portion in the direction of the first convex portion; and

pressing a surface of the at least one plate member with the first electrode member at the first side of the butt portion and surfaces of the at least one plate member on opposite sides of the butt portion, at the second side thereof, with the second electrode member while performing electric resistance heating of the at least one plate member to cause an end face thereof to deform towards the other end face, melt and join with the other end face.

44. The butt welding method of Claim 43, wherein the pair of electrode members are arranged in respective press dies for press-forming the at least one plate member.

EVIDENCE APPENDIX

There is no submitted evidence.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings.